REMARKS

The amendments to the specification correct minor errors. No new matter is believed to be added to the application by this Amendment.

Status of the Claims

Claims 1-24 are pending in the application. Support for claims 23 and 24 can be found at page 8 of the specification.

Rejection Under 35 U.S.C. 103(a) Over Document 1 and Document 2

Claims 1-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Document 1 (Impact Engineering, Nikkan Kogyo Newspaper Ltd., October 28, 1988, pp. 173-183) in view of Document 2 (Nakagawa et al., Lecture Thesis of 16th Series of Chugoku Branch of Japan Design Engineering Society Ass'n, June 20, 1988, pp. 25-29). Applicants traverse.

The Present Invention and Its Advantages

The present invention as is set forth in e.g., claim 1 pertains to a viscoelastic measuring apparatus where the length of the input bar is set so that the reflective strain wave is damped and the re-reflected strain wave is not generated. This feature makes it possible to prevent the strain wave reflected from the rear-end of the input bar and measured with the second and first

gauges from reaching the front end of the input bar. As a result, the apparatus prevents the reflected strain wave from being re-reflected from the front end of the input bar. Consequently, the undesired occurrence that the strain wave reflected from the rear-end of the input bar being measured again with the first and second gauges does not occur.

That is, the present invention analyzes the data of the waveform of the strain wave generated in the input bar in much greater detail than has been heretofore attained by the conventional art. This is shown in Figures 4 and 5 of the application where the interference of each of the strain waves is analyzed by using the waveform of each of the strain waves measured with each strain gauge. In the invention, the length of the input bar is set according to this analysis.

In the invention, it is possible to prevent the strain waves from interfering with each other by setting the length of the input bar to the length (as described in claim 1) so that the re-reflected strain wave is not generated. As a result, only the strain wave to be measured is measured. Therefore, it is possible to measure the value of the strain very accurately and thus measure the viscoelastic characteristic value with a high degree of certainty.

Distinctions of the Invention Over Document 1 and Document 2

Document 1 and Document 2 pertain to a split Hopkinson bar testing apparatus. Document 1 and Document 2 fail to describe the phenomena of the interference of the strain waves. Therefore, Document 1 and Document 2 both fail to disclose or suggest a solution for preventing the interference of the strain waves.

At page 3 of the Office Action, the Examiner admits to failure of Document 1 to disclose many of the aspects of the invention, such as a length set to damp the reflected strain wave, bars made from polymer, bars having a different viscoelasticity than the specimen, percentage spacing, intervals, sections, and a low pass filter. The Examiner also admits that Document 1 fails to teach "a fourth strain gauge."

The Examiner then asserts that many of the aspects of the invention would be a result of design choice or routine experimentation. The Examiner fails to realize these structural details were carefully developed in order to overcome the interference effects associated in determining the elastic modulus of non-hard viscoelastic polymers using a split Hopkinson bar.

In comparison, in Document 1 and Document 2 the strain gauges are used by bonding them to the input and output bars at certain intervals, and the strain is measured by the strain gauge without considering the interference of the waves. Therefore, both Document 1 and Document 2 fail to elucidate whether the measured

strain value is the one to be detected. Thus, the split Hopkinson bar testing apparatus of Document 1 and Document 2 measures the strain value at a low accuracy. That is, Document 1 and Document 2 merely set forth the base construction of a split Hopkinson bar testing apparatus, and any technology for preventing the interference of the strain waves and improving the measuring accuracy is neither disclosed nor suggested by these references.

In contrast, the present invention considers the interference of the strained waves that have heretofore not been addressed by the conventional art. Repeated analyses of the waveform of the strain waves were necessary in order to produce the invention. While the conventional value measuring apparatus of the split Hopkinson bar is incapable of measuring the strain value correctly owing to overlapping of the strain waves, the invention has solved this problem. Therefore, the viscoelastic measuring apparatus of the present invention is capable of measuring the viscoelastic characteristic value correctly.

As has been shown, the combination of Document 1 and Document 2 would fail to motivate a person having ordinary skill in the art to produce the claimed embodiment of the invention. Thus a *prima facie* case of obviousness has not been made. Further, even if it is assumed arguendo that the combination of Document 1 and Document 2 are sufficient to allege *prima facie* obviousness, this obviousness is rebutted by unexpected results.

Unexpected Results

The unexpected results of the viscoelastic measuring apparatus of the invention is set forth in the Tables and examples in the specification. Table 1 starting at page 32 of the specification shows the effect of the positioning of the strain gauges and the results for the example and a comparison example. The interference of the strain waves, i.e., overlapping of waves, is described in detail of the first example and the first comparative example.

First Example

Fig. 4 shows the first example in which an incident strain wave and a reflected strain wave were measured with the first strain gauge and the second strain gauge of the first example, and a transmitted strain wave was measured with the third strain gauge and he fourth strain gauge. As shown in Fig. 4, the result of the measurement of the first example was that peaks Pr1 and Pr2 of the reflected strain wave measured with the first and second strain gauges, respectively occurred once and overlapping of the waves (interference of strain waves) did not occur.

First Comparison Example

Fig. 5 shows the first comparison example in which the strain wave was measured with the first through fourth strain gauges. In

Fig. 5, Pr2 and Pr1 indicate peaks of a first reflected strain wave reflected from the rear end of the input bar. Prr1 and Prr2 indicate peaks of a strain wave generated by the synthesis of a first reflected strain wave reflected from the rear end of the input bar when an incident strain wave was reflected there from and a second reflected strain wave reflected from the front end of the input bar when the first reflected strain wave was reflected there from again. Pt3 and Pt4 indicate peaks of a transmitted strain wave measured at the output rod. Ptr3 and Ptr4 indicate peaks of a strain wave generated by the synthesis of a strain wave reflected from the rear end of the output bar and the transmitted strain wave. Ptrr3 and Ptrr4 indicate peaks of a strain wave generated by the synthesis of a first reflected strain wave reflected from the rear end of the output bar when an incident strain wave was reflected there from, and a second reflected strain wave reflected from the front end of the output bar when the first reflected strain wave was reflected there from again.

As shown in Fig. 5, the first strain gauge measured the peak Pr1 of the first reflected strain wave reflected from the rear end of the input bar having the length of 1000mm, and the peak Prr1 of the second reflected strain wave reflected from the front end of the input bar when the first reflected strain wave was reflected there from again. That is, because the attenuation of the second reflected strain wave does not terminate, the first reflected

strain wave was measured, i.e., the first strain gauge measured the first and second reflected strained waves, which indicates that the first and second reflected strain waves interfered with each other.

Similarly, the second strain gauge measured the peak Pr2 of the first reflected strain wave reflected from the rear end of the input bar and the peak Prr2 of the second reflected strain wave reflected from the front end of the input bar when the first reflected strain wave was reflected there from again.

As has been shown, the combination of Document 1 and Document 2 fail to assert *prima facie* obviousness over the claimed invention. Even if obviousness could be shown, this obviousness is fully rebutted by the unexpected results discussed above. Accordingly, this rejection is overcome and withdrawal thereof is respectfully requested.

Conclusion

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Robert E. Goozner, Ph.D. (Reg. No. 42,593) at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

Attached hereto is a marked-up version of the changes made to the application by this Amendment.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

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2927-0113P

Attachment: Version with Markings to Show Changes Made

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The paragraph beginning on page 8, line 12, has been amended as follows:

--The input bar and the output bar are made of [an] a viscoelastic material; a length of the output bar is set to a range from 500mm to 2500mm both inclusive; and a length of the input bar is set to a range from 1500mm to 2500mm both inclusive.--

Table 1 beginning on page 32, has been amended as follows:

Table 1

Length (mm)	First E	Second E	Third E	[Forth] Fourth E	Fifth E
Length of input bar	2000	1800	2500	1800	2000
Installing position of first strain gauge	900	1200	600	400	1200
Installing position of second strain gauge	600	600	300	200	600
Length of output bar	2000	1000	1500	1800	1000
Installing position of third strain gauge	300	100	200	400	200
Installing position of [forth] fourth strain gauge	600	200	400	800	400
Length of specimen	4	12	8	6	5

Overlapping of waves	◎	◎	◎	○	◎
Noise	◎	○	○	◎	◎

	Sixth E	Seventh E	First CE	Second CE	Third CE
Length of input bar	1700	1500	1000	2800	1000
Installing position of first strain gauge	600	500	900	900	900
Installing position of second strain gauge	300	200	600	600	600
Length of output bar	2500	1000	1000	2800	400
Installing position of third strain gauge	400	100	300	300	200
Installing position of [forth] fourth strain gauge	800	300	600	600	300
Length of specimen	10	7	4	18	4
Overlapping of waves	◎	○	×	Impossible to measure	×
Noise	○	○	◎	Impossible to measure	◎

The paragraph beginning on page 33, line 3, has been amended as follows:

--(Installing position of first strain gauge: the interval from the rear end of the input bar (mm)

Installing position of second strain gauge: the interval from the rear end of the input bar (mm)

Installing position of third strain gauge: the interval from the front end of the output bar (mm)

Installing position of [forth] fourth strain gauge: the interval from the front end of the output bar (mm))--

IN THE CLAIMS:

Claims 23 and 24 have been added.